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Real-Time Intracardiac Echocardiographic Imaging of the Posterior Left Atrial Wall Contiguous to Anterior Wall of the Esophagus

In a recent issue of the *Journal*, Good et al. (1) reported that esophageal location and movement during left atrial ablation can be detected using a barium ingestion–digital cine-fluoroscopic imaging technique. The disadvantages of the barium ingestion–cine-fluoroscopic imaging technique, which they used in the report, include; 1) no real-time imaging during energy delivery of the left atrial posterior wall contiguous to the anterior esophageal wall, which is the most important/only region to be imaged and protected; 2) gaps in barium contrast of the entire esophageal mucosa border that may provide misleading information of the extent of contact along the contiguous posterior left atrial wall; 3) an active effect of barium ingestion on esophageal luminal diameter and movement; and 4) risk of aspiration. In addition, Figures 1A and 1B in the report (1) compare differing anteroposterior projections, creating the illusion of movement that should have been confirmed with the same angled projection.

Intracardiac echocardiography (ICE) can provide real-time imaging of the left atrial posterior wall contiguous to the anterior esophageal wall during energy delivery for left atrial ablation (2). Our ICE studies of esophageal imaging in more than 235 patients showed that the left atrial posterior wall contiguous to the anterior esophageal wall can be imaged in each case. This imaging technique can provide real-time anatomic imaging of this region (3). In addition to anatomic imaging of this region, the ablation catheter tip location and creation of echogenic lesions can also be evaluated during real-time ICE imaging (4). The ICE imaging can guide changes in the energy-delivery strategy to protect the esophagus from damage during ablation in this region and allow for safe lesion delivery in closer proximity to the esophagus than can be safely recommended with the barium ingestion–cine-fluoroscopic imaging technique.

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Please note: Drs. Ren and Callans are the faculty members of AcuNav peer training courses and have received honorarium for the training courses.

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REPLY

Our study (1) describes a simple, practical, and inexpensive method to visualize the position of the esophagus in relation to the left atrium during left atrial catheter ablation in *real-time*. We have the following responses to the points raised by Dr. Ren and colleagues:

1. Because the barium paste typically remains in the esophagus for >45 to 60 min, fluoroscopic imaging of the esophagus after a barium swallow is indeed real-time, and the anterior part of the esophagus is easily visualized.
2. Although there may be gaps in the continuity of mucosal staining after barium is swallowed, one can usually simply extrapolate from the more proximal to distal segments of the esophagus.
3. Although it is possible that barium swallow may facilitate esophageal peristalsis, patients swallow their own saliva during procedures performed under conscious sedation. Furthermore, as already discussed in our study (1) there was no correlation between the prevalence and extent of esophageal peristalsis and the amount of barium swallowed.
4. Aspiration has not occurred during or after barium swallow in over 500 patients who underwent left atrial catheter ablation under conscious sedation in our electrophysiology laboratory.
5. Figures 1A and 1B (1) are identical anteroposterior projections randomly chosen from many examples of esophageal migration. As seen in Figure 1 (1), there is marked migration of the esophagus. This clearly is not an *illusion*.

Finally, we do not dispute that intracardiac echocardiography also may be used for real-time monitoring of the esophagus. However, we find the barium swallow to be much simpler and practical than intracardiac echocardiography.

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Chronotropic Incompetence in Heart Failure

The relationship between heart rate (HR) during exercise and exercise capacity in patients with heart failure due to left ventricular systolic dysfunction remains unclear. The accepted diagnostic criterion for chronotropic incompetence (CI), a maximum age-predicted heart rate (MA-PHR) <85%, is seen in 50% of patients with severe heart failure on contemporary medical therapy (1). Whether the lesser HR rise is the cause of the exercise impairment is less certain: as HR increases as a function of exercise load, it is inevitable that HR at peak exercise will be lower in subjects with worse exercise capacity.

Tse et al. (2) are to be congratulated in trying to explore these issues in their study of patients with cardiac resynchronization devices. However, some important issues were raised by their suggestion that rate-adaptive pacing might be more widely used in patients with resynchronization devices. In patients with the most severe CI, defined as failure to reach 70% of age-predicted maximum HR (n = 11), Tse et al. were able to demonstrate an increase in exercise capacity with rate-adaptive pacing. There are no published data on the incidence of their chosen value of <70%, although it was seen in 28% of patients in our dataset (1).

At first sight, this seems a useful incremental benefit. However, using the more widely accepted definition of failure to achieve 85% of age-predicted maximal HR (3), there was no benefit of rate response pacing. In fact, in one-third of patients with less severe CI (MA-PHR 70% to 85%), there was a reduction in exercise capacity with rate response pacing.

Although CI in chronic heart failure (CHF) patients not taking beta-blockers predicts a worse prognosis (1), lower HRs at rest are associated with improved outcomes in beta-blocker–treated individuals (4). We have also previously demonstrated that HR lowering by aggressive use of beta-blockers does not reduce exercise capacity (1,5). Hence, the issue of CI in patients with severe CHF is not resolved. Furthermore, the long-term effects of rate response pacing and the consequent higher average HR on mortality and left ventricular function are unknown. It is too early to suggest that patients undergoing CRT should have their device's rate response function active.

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REPLY

We thank Drs. Witte and Clark for their interest in our study (1). We agree with their comment that there is no established diagnostic criterion for chronotropic incompetence (CI) for patients with heart failure (HF). The commonly used definition of the age-predicted heart rate (HR) to diagnose CI is traditionally employed for patients with ischemic heart disease. Despite the wide application of rate-adaptive pacing, there is also no established definition of CI for pacemaker patients (2). From a pacing standpoint, the detection of CI is clinically relevant only when there is a functional improvement associated with rate-adaptive pacing. Prior studies have shown that HF patients with CI have lower peak oxygen consumption as compared with those without CI (3). Our data demonstrate that the conventional definition of CI is not applicable to patients with HF implanted with cardiac resynchronization therapy (CRT). Indeed, rate-adaptive pacing was found to be beneficial only in those patients with severe CI who failed to achieve >70% of age-predicted HR, and potentially harmful to patients with mild CI based on the conventional definition. Furthermore, the incidence of CI in HF patients implanted with CRT appears to be higher than for those reported in the general HF population (4). We have evaluated a total of 28 patients and have enrolled 20 patients (71%) with age-predicted HR <85% for this study. This is likely because the current CRT patients have more severe HF (class III to IV) and advanced conduction system abnormalities as compared with the general HF population.

As mentioned by Drs. Witte and Clark, a lower HR at rest predicts better outcome in patients treated with a beta-blocker. The use of rate-adaptive pacing only increases HR during exercise, but not the resting HR, and the increase in 24-h HR due to rate-adaptive pacing is minimal. In fact, the use of rate-adaptive pacing can alleviate the CI to allow more aggressive use of beta-blockers. Consistent with the findings in their recent studies (4), we have shown that the percentage of HR changes during exercise positively correlated with peak oxygen consumption (1). We believe that our data have demonstrated that rate-adaptive pacing is complementary to the use of CRT and optimal medical therapy, including beta-blocker, to improve exercise capacity in